**Правительство Российской Федерации**

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Факультет Бизнес-информатики

**Программа дисциплины** Человеко-машинные интерфейсы

для направления 231000.62 «Программная инженерия» подготовки бакалавра

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## 1. Scope and Regulations

The course "Human-Machine Interfaces" ("System and Software Engineering" BS curriculum, 2nd year) syllabus lays down minimum requirements for student's knowledge and skills; it also provides description of both contents and forms of training and assessment in use. The course is offered to students of the Bachelor Program "Business Informatics" (area code 231000.62) in the School of Software Engineering, Faculty of Business Informatics of the National Research University "Higher School of Economics" (HSE). The course is a part of B.Sc. curriculum pool of required courses (2nd year, СД.00 section Special disciplines of the 2012-2013 academic year's curriculum), and it is a single-module course (semester B quartiles 3 and 4). The duration of the course amounts to 121 class periods (both lecture and seminars) divided into 32 Lecture hours (L) and 89 Seminar (S) hours. Also, 27 academic hours are intended fore students' Self-Studying (SS) activity.

The course is delivered for the bachelor's students of the National Research University-Higher School of Economics, business-informatics faculty, Software Engineering Department. The First one is "Software Construction" and the second one is "Software Engineering Approach to Human - Computer Interaction" (hereafter simply called "Human – Computer Interaction").

This course starts with the basic principles of user-interface and interaction design. We discuss usability and user-experience issues and cover some basic cognitive principles that guide interaction design. We cover interaction styles (direct manipulation, command-language, etc.) and how to select the best style for each application area. We introduce user-centered and participatory design for developing usable interfaces. We discuss basic technology for graphical user interfaces for windowing systems and Web-based and mobile interfaces. For implementing actual interfaces knowledge of Java (from the Software Construction course) is built upon in order to design and implement a mobile interface for Android. Evaluation of interfaces is done without users (through heuristic evaluation, cognitive walkthrough and action analysis) and with users (where we concentrate on the thinking aloud method).

The syllabus is prepared for teachers responsible for the course (or closely related disciplines), teaching assistants, students enrolled on the course "Human-Machine Interfaces" as well as experts and statutory bodies carrying out assigned or regular accreditations in accordance with

- educational standards of the State educational budget institution of the Higher Professional Education "State University – The Higher School of Economics" (HSE) categorized as "National Research University",
- MS curriculum ("System and Software Engineering", area code 231000.62), Software Development Management specialization, 1st year, 2012-2013 academic year (approved in July 2012); HSE Standard: http://www.hse.ru/data/2012/08/27/1242910132/ProgInzh%20mag.pdf,
- Federal state educational standard of higher education in software engineering (Master of Science degree) approved by the Ministry of Education and Science of RF (Russian Federation) Directive N543 on November 9th, 2009 (in Russian).

## 2. Course Objectives

After this course the student should be able to elicit a set of requirements for, design, implement and evaluate (empirically) highly usable user-interfaces for a wide variety of application areas.

Students will attend lectures (for motivation, explanation of theory and examples, feedback on previous work, questions and discussion, in preparation for assignments), read study material (to learn about interaction design and evaluation), and work on practical group assignments that focus on evaluation and on interface design and implementation.

## 3. Learning Outcomes

Upon mastering the discipline, the successful students will:

- Know:
  - what is required for user interfaces to have good usability; what can be expected from users (considering cognitive and physical abilities); which user interface technologies fit which types of applications.

- Be able to:
  - elicit requirements for interactive applications; design interfaces and build prototypes; evaluate usability of interactive applications.

- Acquire skills/experience in:
  - prototyping; evaluation with and without users; technology for web-based and mobile interfaces, especially in Java for Android and in HTML5.

## 4. The Course within the Program Framework

The course is within the special courses cycle and the block of basic disciplines.

The course is based on the students' knowledge of mathematics, basics of information science, algorithm theory, and OOAD, and on modeling skills for methodological search of the solution. The course prerequisite is successful completion of the Software Construction course (because it is used to design and implement a user-interface), common sense, good knowledge of English (because there are often descriptions of situations, given in English).

## 5. Topic-Wise Course Contents

| No | Topic Name | Course Hours, Total | Audience Hours | | Self-Study |
|---|---|---|---|---|---|
| | | | Lectures | Practical Studies | |
| **Module 3** | | | | | |
| 1 | Example-based introduction | 4 | 2 | 1 | 1 |
| 2 | Design principles for usable designs | 8 | 4 | 1 | 3 |
| 3 | Usability principles | 8 | 4 | 1 | 3 |
| 4 | Cognitive aspects: understanding users | 8 | 4 | 1 | 3 |
| 5 | Evaluating interfaces, including group assignment | 24 | 2 | 20 | 2 |
| | **Module 3, totally:** | 52 | 16 | 24 | 12 |

| No | Topic Name | Course Hours, Total | Audience Hours | | Self-Study |
|---|---|---|---|---|---|
| | | | Lectures | Practical Studies | |
| **Module 4** | | | | | |
| 6 | Selecting an appropriate UI style for the user's task | 8 | 4 | 1 | 3 |
| 7 | The process of UI and Interaction design and development | 8 | 4 | 1 | 3 |
| 8 | Hardware and Software issues for graphical interfaces | 4 | 2 | 1 | 1 |
| 9 | New interaction devices | 4 | 2 | 1 | 1 |
| 10 | UI development using Java for Android, including group assignment | 4 | 2 | 60 | 6 |
| 11 | UI development using HTML5 | 4 | 2 | 1 | 1 |
| | **Module 4, totally:** | 96 | 16 | 65 | 15 |
| | **TOTAL:** | 128 | | | |

Notes:

1. Each No above should correspond to the separate theme, the theme may span over one or more lectures .
2. Module above is about a half of semester. Modules 1 and 2 belong to the first semester, while modules 3 and 4 belong to the second semester. For the first semester the Total must be 14 lectures (i.e. 28 hours for lectures). For the second semester – 16 lectures (2 hours per lecture). Your taks is to fill the Topic Names and Lectures columns - correspondingly.

## 6. Course Assessments

| Assessment Type | Assessment Form | Parameters ** | |
|---|---|---|---|
| | | 1 | |
| Intermediate (week) | Test | Week 16 | multiple choice exam 60 mins |
| | Essay | Week 8 | report on a user interface evaluation |
| Final | Prototype+Demo | Week 16 | prototype + documentation + 40 minutes demo and interview |

The overall course grade *G* (10-point scale) is calculated as a sum of:

$$G = 0{,}2\ T + 0{,}2\ \mathrm{E} + 0{,}6\ \mathrm{P},$$

where *T* is the written final test grade, *E* is the practice activity on evaluating interfaces, and *P* is the project on designing and implementing a (mobile) interface.

It is rounded (up or down) to an integer number of points. Taking part in all three elements of assessment is required to obtain a final grade.

**Summary Table : Correspondence of ten-point to five-point system's marks**

| Ten-point scale [10] | Five-point scale [5] |
|---|---|
| 1 – unsatisfactory<br>2 – very bad<br>3 – bad | Unsatisfactory – 2 |
| 4 – satisfactory<br>5 – quite satisfactory | Satisfactory – 3 |
| 6 – good<br>7 – very good | Good – 4 |
| 8 – nearly excellent<br>9 – excellent<br>10 – brilliant | Excellent – 5 |

### 6.1. Assessment Criteria

Intermediate Assessments: Module 3 –an essay about the evaluation experiment (performed in groups of 3 students). One (10-point scale) grade is given for the essay.

Final Assessments: Exam at the end of Module 4, about topics of Module 3 and 4.

The multiple-choice test is to assess the core course content. It is done during the practical studies. The time limit is 60 mins. One (10-point scale) grade is given for the test.

The main part of the grade comes from the final assignment which is to design and implement a progotype user-interface. This group assignment (groups of 3 students) must result in an essay describing the design and use of the prototype, the source code and the fully functional code of the prototype. Each group has to give a demo and answer questions about the interface (during a 40 minute session per group). This assignment results in one (10-point scale grade.

## 6.2. Course Evaluation

One (10-point scale) grade is given for each assessment. The ratio between the three grades leading up to the final grade is 20-20-60.

## 7. Detailed Course Contents

**Topic 1: Example-based Introduction** In this introduction the difficulty of designing usable interfaces is illustrated with some examples. Issues that are described (that are all treated more in depth later) involve questions like “why does a better design not necessarily become popular?”, “what are common problems with interfaces?” and “why do people come up with bad designs?” and “what does it take to come up with good designs?”.

Readings:

Core:

- Designing the User Interface (5th edition), by Ben Shneiderman and Catherine Plaisant (international edition) Pearson, ISBN-13: 978-0-321-60148-3, 2010, chapter 1.

Optional:

- Interaction Design (2nd edition), by Rogers, Preece and Sharp, Wiley, ISBN-13: 978-0-470-01866-8, 2007 (recommended optional literature)., chapter 1.

**Topic 2: Design Principles** Good (usable) interfaces are a natural consequence of following good design principles. We study the principles of *visibility*, *feedback*, *constraints*, *mapping*, *consistency* and *affordances*. They focus on *what helps you create* usable interfaces.

Readings:
Core:

- Designing the User Interface (5th edition), by Ben Shneiderman and Catherine Plaisant (international edition) Pearson, ISBN-13: 978-0-321-60148-3, 2010, chapter 2.

Optional:

- Interaction Design (2nd edition), by Rogers, Preece and Sharp, Wiley, ISBN-13: 978-0-470-01866-8, 2007 (recommended optional literature)., parts from chapter 2.

**Topic 3: Usability Principles** Following up on the design principles we study *prescriptive* usability principles that can later be used in evaluating interfaces (to check whether the designers followed the principles). The main principles are *visibility of system status*, *match between system and the real world*, user control and freedom, *consistency and standards*, *help users recognize, diagnose and recover from errors*, *error prevention*, *recognition rather than recall*, *flexibility and efficiency of use*, *aesthetic and minimalist design*, *help and documentation*. We also look at the issue of *quality of service* which is not strictly speaking a usability theme but greatly affects usability.

Readings:
Core:

- Designing the User Interface (5th edition), by Ben Shneiderman and Catherine Plaisant (international edition) Pearson, ISBN-13: 978-0-321-60148-3, 2010, fragments from chapter 10-14.

Optional:

- Interaction Design (2nd edition), by Rogers, Preece and Sharp, Wiley, ISBN-13: 978-0-470-01866-8, 2007 (recommended optional literature)., parts from chapter 2.

**Topic 4: Understanding Users** In this part the course touches upon some aspects from psychology: the *cognitive* aspects. They help us understand what users are capable of and what not in order to take these capabilities and limitations into account in user interface design. Specific cognitive aspects are *attention*, *perception and recognition* and *memory*. We consider applications of these aspects in *learning*, *reading, speaking and listening*, *problem solving*, *planning*, *reasoning and decision making*.

Readings:
Core:

- Designing the User Interface (5th edition), by Ben Shneiderman and Catherine Plaisant (international edition) Pearson, ISBN-13: 978-0-321-60148-3, 2010, parts of chapter 3.

Optional:

- Interaction Design (2nd edition), by Rogers, Preece and Sharp, Wiley, ISBN-13: 978-0-470-01866-8, 2007 (recommended optional literature)., chapter 3.

**Topic 5: Evaluation** The usability of an interface needs to be evaluated empirically. This can be done with or without involving actual users. Evaluation without users consists of *cognitive walkthrough*, *action analysis* and *heuristic evaluation*. Evaluation with users consists of *field studies*, *qualitative analysis* using the *thinking aloud method* and *quantitative analysis* through *logging* and *surveys*. The evaluation part of this course involves a group project to evaluate an existing (production) user-interface.

Readings:
Core:

- Designing the User Interface (5th edition), by Ben Shneiderman and Catherine Plaisant (international edition) Pearson, ISBN-13: 978-0-321-60148-3, 2010, chapter 4.

Optional:

- Interaction Design (2nd edition), by Rogers, Preece and Sharp, Wiley, ISBN-13: 978-0-470-01866-8, 2007 (recommended optional literature)., chapters 12-15.

**Topic 6: Selection of Interface Style** One of the important steps in UI development is selecting which interface style best matches the needs of a new application to be developed. We consider choosing between *direct manipulation, menu selection, form fill-in, command and natural language* and *exploring, browsing and reading*.

Readings:

Core:

- Designing the User Interface (5th edition), by Ben Shneiderman and Catherine Plaisant (international edition) Pearson, ISBN-13: 978-0-321-60148-3, 2010, chapter 5-9.

Optional:

- Interaction Design (2nd edition), by Rogers, Preece and Sharp, Wiley, ISBN-13: 978-0-470-01866-8, 2007 (recommended optional literature)., chapter 6.

**Topic 7: Prototype development** In this part we investigate the *process* of designing a user interface, based on the method of *participatory design*. The process involves finding users, determining the users' needs, choosing a conceptual model, considering alternative designs (in brainstorming), designing paper and software prototypes, and decomposing tasks into steps (each of which requiring some interaction). Of course the development also entails evaluation but that is covered as a different topic.

Readings:

Core:

- Designing the User Interface (5th edition), by Ben Shneiderman and Catherine Plaisant (international edition) Pearson, ISBN-13: 978-0-321-60148-3, 2010, chapter 3.

Optional:

- Interaction Design (2nd edition), by Rogers, Preece and Sharp, Wiley, ISBN-13: 978-0-470-01866-8, 2007 (recommended optional literature)., chapter 9-11.

**Topic 8: Hardware and software issues** Developing (implementing) a graphical user interface goes beyond mere programming. We discuss specific issues about dealing with screen size and resolution, windows and widgets, modal and non-modal interfaces, event handling and multitasking within a UI.

Readings:

Core:

Slides used during the course (mostly not covered by the books).

**Topic 9: New devices and interaction** In this part we look into the future and study interaction *devices* and how we can come up with usable new designs.

Readings:

Core:

- Designing the User Interface (5th edition), by Ben Shneiderman and Catherine Plaisant (international edition) Pearson, ISBN-13: 978-0-321-60148-3, 2010, chapter 8.

**Topic 10: Interface development with Java for Android** This is a tutorial on how Java programming for interfaces, and specifically for the Android platform is different from Java programming in general. This is an example-based tutorial with step by step instructions needed to get going with the development of Android interfaces (using Java and Eclipse). The interface development is practiced in a group assignment which forms the major assessment part of the course.

Readings:

Core:

Slides used during the course (mostly not covered by the books).

**Topic 11: Interface development with HTML5** This is a tutorial on developing platform-independent browser-based interfaces by making use of the latest in Web-based front-end technology: HTML5. While not yet completely specified and implemented we can already have a glimpse at what future interface development in HTML5 will be like. (The assignment uses the more established Java for Android development, not yet HTML5.)

Readings:

Core:

Slides used during the course (mostly not covered by the books).

## 8. Learning Technologies

- http://sakai.win.tue.nl/ (learning management system on which you can access the course for HSE. This site contains downloads, schedule information, group assignments, etc.)
- Slides, assignment descriptions, various handouts

## 9. Assessment Tools for Intermediate and Final Course Evaluation

### 9.1. Intermediate Assessment Topics

**Written Test topics:**

♦ **Multiple-choice exam:**

This exam tests the students' knowledge of topics 1-11 (see section 5: Topic-Wise Course Contents). It contributes for 20% towards the final grade.

♦ **Evaluation of interfaces assignment**

In this group assignment an existing (production) interface is evaluated (for usability issues). An evaluation report has to be written. This report is graded and contributes for 20% towards the final grade.

♦ **Design and implementation of interfaces assignment**

The main assignment of this course is the design and implementation of a new interface. The design process and the prototype description need to be documented in a report. The interface itself must be created using either Java for Android or HTML5. (We expect students to be better prepared to use Java for Android than HTML5 but leave the choice up to the students.). The assessment is mainly based on the externally observable behavior of the interface (we try to actually use the interface) and partly on the report. The actual code (implementation quality) is not considered for the grading. This group assignment contributes for 60% towards the final grade.

## 10. Courseware Readings and Reference Materials

### 10.1. Basic Readers

- Designing the User Interface (5th edition), by Ben Shneiderman and Catherine Plaisant (international edition) Pearson, ISBN-13: 978-0-321-60148-3, 2010.
- Slides, assignment descriptions, various handouts

### 10.2. Reference Books

Detailed information is available on the course web page at

- http://sakai.win.tue.nl/ course HCI for HSE

### 10.3 Additional Readings and References

- Interaction Design (2nd edition), by Rogers, Preece and Sharp, Wiley, ISBN-13: 978-0-470-01866-8, 2007 (recommended optional literature).

### 10.4. Software

To successfully master the course, the students use the following software items:

- Java for Android: Java version 1.6 or later. The Sun (Oracle) version of Java is needed, not the Open JDK. Android Development Tools version 17 or later.
- Eclipse IDE for Java Developers, Helios Service Release 2 or later.

### 10.5. Distance Learning

The distance learning of the course is supported by the http://sakai.win.tue.nl/ (learning management system on which you can access the course for HSE. This site contains downloads, schedule information, group assignments, etc.). The … courseware contains lecture notes, seminar materials, self-preparation tests, as well as intermediate and final assessments.

## 11. Technical Support

OHP for lectures and classes, computer classes for seminars with Java and Eclipse software pre-installed.

Author of the syllabus: _____ Paul De Bra